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A NOTE ON THE RELATION BETWEEN INPUT-OUTPUT AND INCOME AND PRODUCT ACCOUNTING SYSTEMS

Por

Angel L. Ruíz Mercado, Ph.D.
Catedrático Asociado

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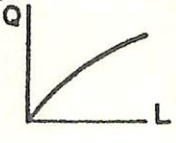

N O T A

En este trabajo el autor compara dos sistemas de contabilidad social, el de Ingreso-Producto y el de Insumo-Producto. También ofrece un breve resumen histórico de ambos. Para la ilustración empírica se usa una versión agregada del último cuadro de insumo-producto estimado por la Junta de Planificación, el del año fiscal de 1972. Este artículo es parte de la labor de investigación que está llevando a cabo el autor durante su año de licencia sabática que eventualmente redundará en la publicación de un libro sobre el tema.

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A NOTE ON THE RELATION BETWEEN INPUT-OUTPUT AND INCOME AND PRODUCT ACCOUNTING SYSTEMS

Angel L. Ruíz Mercado, Ph.D.*

I. HISTORICAL BACKGROUND OF SOCIAL ACCOUNTING SYSTEMS

A. National Income and Product Accounts

There are several types of social accounting systems. Among the best known are the National Income and Product accounts the Interindustry Accounts and the Money Flows or Flow of Funds system.[1/] The choice among any of these systems will depend on historial exigencies of the analytical purposes in mind.[2/] No system of social accounting could claim supremacy over other systems. Some of their concepts overlap and some are brought to light which are not part of the others. It is better to approach these systems as complementing each other and view them as part of quantitative research in social accounting framework. However, for our purposes national income and product accounts, although very useful for certain purposes, are rather limited in scope since this type of account does not penetrate deeply enough inside the economic structure. Since input-output system goes beyond the consolidated production and income accounts the ideal would be an integrated system of accounts as well as some type of international standard of structuring and presenting them.[3/] This will facilitate the analysis of the structure of individual economies as well as international comparisons.

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*Professor of Economics College of Social Sciences, University of Puerto Rico, Río Piedras.

In what follows I will briefly review some of the historical developments in the national income and interindustry social accounting systems. The Flow of Funds system will not be included since it falls outside the scope of this study.

According to Schumpeter reference to what we call national income and product was already found, although not expressed in the terminology we use nowdays, in writers like Sir William Petty (1623-87), Quesnay (1694-1774) and a french contemporary of Adam Smith, Jean J.L. Graslin (1727-90). Talking about Sir William Petty Schumpeter argues that although "he did not bother about its definition (of national income) ... he recognized its analytical importance and he tried to figure it out". In France, in his Essai Analytique, J.J. L. Graslin "presents the outlines of a comprehensive theory of wealth as a theory of total income rather than of income net of all producer's expenses including wages". Referring to Quesnay "a glance at the Tableau suggests the idea of a social product or total output that is produced in one series of steps and 'distributed' in another". This concept of total annual output and its value was "adopted by Adam Smith".[4/]

Adam Smith's contributions to national income and production theory are imbeded in his concept of wealth and in his treatment of labor productivity. For him the wealth of a country was "the whole annual produce of their land and labour", or alternatively, "the gross revenue of all the inhabitants of a great country... the whole expense of maintaining the fixed capital, must evidently be excluded from the neat revenue of the society.[5/] It is clear that, given some technicalities, this can be interpreted as gross national product, gross income, and net national income respectively.

In his chapter on "productive and unproductive labour" Smith distinguished between productive and unproductive activities. Productive activities were related only to the production of material goods. Services were not considered as production.[6/]

Although some economists of the epoch, like David Ricardo[7/] found some faults in the definition given by Smith, most of them -including Say and J.S. Mill- accepted it with minor modifications.[8/]

In relation to Smith's concept of productivity, it formed the basis of some of the original national income estimates in England and France for almost a century. It was not until late 19th century, when Alfred Marshall identified production of goods and services with the concept of utility, that a broader concept of production was adopted.[9/]

According to Schumpeter Marx adopted Smith's concept of productive and unproductive labor (and accordingly a distinction between material production and services).[10/] Most people agree that the roots of national income and product accounts in today's Soviet Union are to be found in Marx's writings.[11/] In the Soviet Union national income is defined as a aggregate of net material output excluding most services. In relation to whether the Soviet Union adopted this concept from Marx or not, Mr. Vaclav Holeseusky thinks that the latter is true. According to him: "there is a good deal less conflict between Marx's writings and the Western Concept of National income than there is between Marx and the Soviet theories on the subject.[12/]

In the United States it is not until mid-19th century that studies on measurements of national income appeared. In 1920's the National Bureau

of Economic Research published various studies related to the factor payments aspects of national income accounting.[13] Spurred by the 'Great Depression' and the policies of the 'New Deal' the Federal Government's participation in this field followed with the work begun by the U.S. Department of Commerce in 1932. The efforts were focused mainly in the aggregative aspects of National Income. For the first time this Department prepared estimates of national income on an official basis which later were published in the Survey of Current Business in 1942 and an accounting form in 1947. Since these dates, various revisions and refinements have been adopted which have culminated in Today's system of five interlocking accounts: National Income and Product Account, Personal Income and Outlay Account, Government Receipts and Expenditure Accounts, Foreign Transactions Accounts, and Gross Savings and Investment Accounts.

B. Interindustry Accounting: A Brief Historial Background

Input-output accounting system can be viewed as an extension of the national income accounting system depicting the flows of intermediate transactions. The origin of this system of accounting can be traced back to Quesnay Tableau Economique.[14] The Tableau was first published in 1758 and it was aclaimed by some people of that epoch, and of later dates, as one of the greatest contributions to the physiocratic school of thought.[15] Some other economists, however do not share this opinion. For instance, M. Blaug thinks that "it should not be regarded as the centerpiece of the physiocratic system. What it achieved was a vivid graphic picture of general interdependence by means of a drastic simplification of the economic system into three interacting sectors".[16]

Quesnay's Tableau Economique can be interpreted as a Leontief closed static accounting system (or analytically as a simple Leontief closed static input-output model) and in this way his analysis of the circular flow of economic activity becomes clearer and more powerful.

The following example (reproduced from A. Phillips' article) will illustrate the point. The following transaction able is constructed from information contained in the Tableau.

TABLE 1

TRANSACTION TABLE FOR THE TABLEAU ECONOMIQUE

(VALUE OF REAL GOODS IN MILIARDS)

Producing Industries	Purchasing Industries			Total Production
	I Farmers	II Proprietors	III Artisans	
I. Farmers	2	1	2	5
II. Proprietors	2	0	0	2
III. Artisans	1	1	0	2
Total Purchases	5	2	2	9

Production of farmers is 5 milliards, two of which they keep. One Milliard is sold to proprietors and another two milliards are sold to artisans. Farmer's own purchases are two milliards from their goods, two milliard of rental services and one milliard from the artisans. Proprietors produce 2 milliards of rental services all of which is sold to farmers. Artisans produce two milliards of goods half of which is purchased by proprietors and half by farmers. In this way the Tableau, is presented

in Input-Output accounting framework. From the analytical point a three industry closed Leontief model can be illustrated by the following system of Equations:

$$(1)\quad (1 - A_{11})\, X_1 - A_{12}\, X_2 - A_{13}\, X_3 = 0$$

$$- A_{21}\, X_1 + (1 - A_{22})\, X_2 - A_{23}\, X_3 = 0$$

$$- A_{31}\, X_1 - A_{32}\, X_2 + (1 - A_{33}) = 0$$

Where:

X_i = Output $i = 1, 2, 3$

A_{ij} = Technical Coefficients

$A_{ij} = Xij/Xj$

Since this is an homogeneous system, the equations are met by any set of values for X_1, X_2 and X_3, given they are in the same proportions (when only the coefficients are given).

Recognition that Quesnay was one of the most important pionner of interindustry accounting and analysis was given by the person who years later became one of the greatest contributor to this sort of analysis. W. Leontief introduced Part I of his classic book by mentioning that "the statistical study presented in the following pages may be best defined as an attempt to construct... a Tableau Economique of United States for 1919 and 1929".[17/]

Before Leontief, empirical and theoretical contributions to Input-Output Economics were mostly restricted to general equilibrium models without much empirical content. In Professor P.N. Mathur's words: "while theoriticians were busy with the creation of more 'empty boxes' and

gaining expertise in implicit theorizing, the empiricists were using more and more sophisticated statistical tools in their measurements without theory; Leontief baldly, chalked out a practical program aimed at the fusion of the two".[18]

After this brief historical background in what follows the two system are compared and the equations linking the same are shown. Finally in part III, an example with Puerto Rican data will be offered.[19]

II. TOWARD AN INTEGRATED SYSTEM OF NATIONAL INCOME AND INTERINDUSTRY ACCOUNTS

There are important differences as well as similarities between National Income and Interindustry Accounting Systems. However, many of the so called differences are not clearly demarcated, the differences being rather in the extend of coverage or degree of treatment of certain aspects of their structures. Differences between the systems can be classified according to 'scope' or 'orientation', accounting structures, transactions coverage and sectoral coverage.(20)

The scope or orientation of both types of accounts has to do with the aspects of the economy they focus on and the analytical purposes for which they are appropiate and useful. For instance, while national income is more concerned with measurements of production of goods and services at market prices and the distribution of claims against this production in aggregative terms, input-output accounting is more interested in the problem of interindustrial relations of the production process and the technological interconections between inputs and outputs in a disaggregative fashion.

Although originally these systems could have been designed with same specific analytical purpose in mind, they are not in any way uniquely restricted to any particular analytical formulation. As one writer points out: "The original purpose... is not always a controlling element in the ultimate orientation of a statistically implemented system... once a social accounting system is brought into existance it tends to lead a life of its own, with its development often determined by the logic of its own requirements.[21]

The historical development of analytical uses of national accounts in Business Cycle Theories, in aggregative Keynesian and Post-Keynesian static and dynamic models, and in aggregative econometric models[22] is illustrative of the above statement. But the analytical potential of interindustry accounting is even more dramatic and more powerful than the aggregative national income accounting. Apart some of the controversial aspects concerning some of the assumptions of input-output models[23], its applications (in addition to the traditional one of estimating requirements of real flows of goods and services from different stated final demand conditions) cover fields like International Trade, Economic Development, Economic Planning, Regional Economics and others.[24]

The accounting structure of the two systems is another basis for comparison. In this sense they could be classified as double-entry accounting systems.[25] Both also could be said to be conceptually on an accrual basis although they may include some transactions which could be classified on an non-accrual basis. A comparison of similarities and differences of the two system could be made more specifically according to which type of transactions they consider on an accrual basis.

Comparisons according to transaction coverage can be made comparing the two systems treatment of 'imputed transactions'. For instance, imputed transactions play a larger role in input-output system. Also this later system makes greater use transactions expressed on gross basis (rather than net) than national income system.

Finally sectoring in social accounting systems could be formulated on institutional or activity basis. Both systems use activity sectoring - their sectors isolate activities rather than economic units.[26] On this basis several sector could be distinguished. For instance in both systems a distinction is made between final and non-final sectors (or 'endogenous versus exogenous'). In input-output analysis the non-final sector plays an important role while in national income it is 'netted-out'.

Bearing in mind some minor differences as discussed in the above context (and the 'thorny' problem of data) a bridge linking the two system has been built by early contributors in this field.

Many countries have also implemented empirically this relation by developing a system of social accounting that integrate both systems. One example is the United States. In 1958 the U.S. Department of Commerce prepared an Input-Output table as "an integral part" of U.S. national economic accounts.[27]

The relation between the two systems of accounting can be illustrated formally using some simple accounting equations. The following accounting model taken from Chenery and Clark[28] will be used as an example:

Definitions:

Z_i = total supply of good i

X_i = total production of good i

M_i = imports of good i

X_{ij} = amount of good i consumed in sector j

Y_i = final demand of good i

W_i = total intermediate consumption of good i ($\sum X_{ij}$)

M_j = total intermediate inputs purchased by sector j from other industries ($\sum_i X_{ij}$)

V_j = total consumption of primary inputs (value added) by sector j.

These concepts can be summarized in two equilibrium equations. The first equation is arrived at by reading the Input-Output matrix rowise. It means that for each good total supply is equal to total demand, this later being equal to final plus intermediate demand or:

$$(1) \quad Z_i = M_i + X_i = \sum_j X_i + Y_i = W_i + Y_i \quad (i=1,..,n)$$

The second equation is derived reading the input-output matrix columnwise. It shows that total production in each sector is equal to intermediate inputs purchased from other sectors plus value added in this sector or:

$$(2) \quad Xj = \sum_i X_{ij} + Vj = Uj + Vj \qquad (j=1,...,n)$$

Starting from the above two equations the relation between inter-industrial and national income accounts can be easily illustrated. Adding the equilibrium equation (1) for each row and deducting imports from final demand we obtain:

$$(3) \quad \sum_i Xi = \sum_i \sum_j Xij + \sum_i Yi - \sum_i Mi$$

Adding equation (2) Columwise we obtain

$$(4) \quad \sum_j Xj = \sum_j \sum_i Xij + \sum_j Vj$$

Since $\sum_i Xi = \sum_j Xj$ both equations are equal,

Combining them and eliminating from both the interindustry transactions we obtain the basic national income and product account identity

$$(5) \quad \sum_i Yi - \sum_i Mi = \sum_j Vj$$

As a concluding comment on this section it is worth to emphasize that if input-output accounting cover more or less the same information as national income and product and it goes beyond in covering the intermediate flows, an effort should be made to integrate both systems. There is hardly no doubt that input-output accounting has many advantages over national income and product. These advantages are true whether you consider the pure accounting aspect or the analytical uses. From the pure accounting point of view if one of the purposes of both is measuring unduplicated final output the input-output system is a more rigorous system of verification since balances of gross input and output must be achieved for each intermediate sector. As some writer points out "the input-output accounts will be useful and valid for demostration and consistency checking purposes even if we reject input-output theory.[29/]

From the analytical point of view input-output models go beyond national income aggregate models in many respects. It suffices to say at this point that in input output models a relation is made of all the

relevant inputs (including capital input in dynamic versions) required to support projected patterns of final demand relating demand requirements to supply while aggregate models are developed with almost no regard for supply aspects.[30]

III. THE TWO ACCOUNTING SYSTEM: THE CASE OF PUERTO RICO

A. The Transaction Table

An input-output matrix or table is also known as a transaction matrix. In such a matrix or table, all the sectors that have been specified as defining the economy are shown as rows and columns. Consequently, this portion of the system is square because it has as many rows as columns. A row represents outputs (or total sales). The products and services sold by the sector named for that row. A column represents inputs. Current inputs delivered to a certain industry by all other industries. These inputs and outputs, or exchanges, of products and services between the sectors of the domestic economy are shown in dollars. reflecting sale prices. Any cell in a transaction matrix, therefore, depicts all the transactions that ocurred in a year between all the individual firms comprising that sector and all the firms in another sector. Thus, all cells in this square matrix depict all transactions between all local sectors of a given economy in a year.

"Outside" the square matrix - to the right - we have a rectangular matrix, its columns show deliveries from the various industries for the different kinds of final use. These final uses are classified as consumption, investment government expenditures and exports. Consumption,investment

government expenditures, and exports may be broken down in many ways. In our case consumption is broken down into durables, non durables and service. Investment is divided in changes in inventories, construction and machinery and equipment. Government expenditures are those of commonwealth and municipal governments and exports are classified in merchandize and services, tourist expenditures and federal government expenditures. Exports are often defined as net exports. that is, the exports minus imports. In the case of our input-output system imports are shown as a vector with negative sign. Included in the vector of imports are the intermediate plus the final imports.

Below the interindustry square is a rectangular matrix its rows showing the deliveries of various factor services; labor, capital, natural resources (or land) and entrepeneurship to the individual industries, as well as a vector of imported inputs. These are called "primary" inputs. The primary inputs receive payments in the form of wages and salaries, rents, interests and profits. If added together in a vector these factor payments are called value added. The value added also includes indirect business taxes (minus subsidies) and depreciation.

To make the exposition clearer Table 2 presents a social accounting system for the Puerto Rican economy including a 9 by 9 interindustry transaction matrix for fiscal year 1972.

If we read the table accross the columns we observe that total gross output is equal to the sum of intermediate demand plus final demand. If we read the table across the rows it says that total gross outlay is equal to the sum of intermediate inputs plus value added. It is observed that

TABLE 2

INTERINDUSTRY TRANSACTION TABLE FOR THE PUERTO RICAN ECONOMY

(1972=100)

	INTERMEDIATE DEMAND								DOMESTIC FINAL DEMAND							
	Agriculture	Mining	Construction	Manufacturing	Transportation, Comunication and Public Services	Trade	Finance, Insurance and Real Estate	All other Services	Government	Total Intermediate Demand	Final Consumption	Investment Expenditures	Government Consumption	Exports of Goods and Services	Final Demand, Total	Imports[1] (minus)	Total Output
Agriculture	3,791	2	6,354	202,935	121	1,306	133	1,510	10,869	227,021	52,990	8,228	-----	19,608	80,826		307,847
Mining	-----	3	5,092	11,173	159	-----	3	22	4,483	20,935	------	1,543	-----	249	1,792		22,727
Construction	1,136	46	482	13,713	3,752	31,514	22,225	9,723	20,503	103,094	------	1,109,764	-----	------	1,109,764		1,212,858
Manufacture	33,116	3,536	276,195	1,011,381	96,115	68,383	52,888	53,291	107,764	1,702,669	790,887	129,536	-----	1,880,724	2,801,147		4,503,816
Transportation, Communication, and Public Services	15,009	2,228	13,916	133,413	39,763	48,280	23,200	37,636	371,190	371,190	276,107	140,981	-----	118,702	535,790		906,980
Trade	16,928	1,149	58,365	135,541	37,279	16,176	11,951	32,645	37,304	347,338	1,063,910	133,324	-----	80,767	1,278,001		1,625,339
Finance, Insurance, and Real Estate	6,835	1,434	61,377	71,258	34,955	92,283	81,939	50,490	46,890	447,461	638,481	6,647	-----	27,036	672,164		1,119,625
All Other Services	3,075	1,737	80,202	72,730	36,817	29,223	30,156	32,068	26,529	312,537	440,368	--------	-----	149,661	590,029		902,566
Government	687	15	856	10,285	2,251	1,741	21,993	827	1,805	40,460	139,787	30,254	1,255,806	------	1,428,847		1,469,307
Totals, Domestic (Intermediate and Final)	80,577	10,150	502,839	1,662,429	251,212	298,371	269,568	203,776	293,783	3,572,705	3,402,530	1,560,277	1,255,806	2,276,747	8,498,360		12,071,065
Imports	45,130	2,440	208,498	1,284,973	92,382	88,463	82,649	77,064	130,577	2,012,176	1,219,453	324,697	-----	177,322	1,721,472	(3,733,648)	------
Value Added	182,140	10,137	501,521	1,556,414	563,386	1,238,505	767,408	621,726	1,044,947	----------	----------	----------	-----	----------	----------	----------	------
Total Purchases (Intermedinte and Final	307,847	22,727	1,212,858	6,503,816	906,980	1,625339	1,119,625	902,566	1,469,307	5,584,881					10,219,832	(3,733,648)	12,071,065

total gross outlay is equal to the gross output and in the aggregate total value added is equal to final demand establishing in this way a 'bridge' between national accounting identity and input-output accounting system.

The following is a numerical example of the above mentioned definitions as applied to the manufacturing sector. Table I shows that manufacturing sales amounted to $4,503.8 millions, of these $1,702.7 millions were intermediate and $2,801.1 millions were final sales. More especifically

7. $4503.8 = 33.1 + 3.5 + 276.2 + 1011.4 + 96.1 + 68.4 + 52.9 + 53.3 + 107.8 + 2801.1$

In mathematical symbols the equation for total sales will look as follows (manufacturing is sector member 4 in Table 1):[31/]

7-A. $X_4 = X_{41} + X_{42} + X_{43} + \ldots + X_{49} + Y_4$

As especified before, X_i stands for total manufacturing sales (or total output), Xij intermediate sales, and Yi final demand. In other words, for the whole economy the equation will look like :

7-B. $X_i = \sum_{j=1}^{n} X_{ij} + Yi$

Now let's examine the column corresponding to the manufacturing sector. We can readily see that total outlays are equal to purchases of

domestically supplied intermediate inputs plus imported intermediate inputs plus factor payments (or value added). In numerical form the manufacturing sector total outlays are (in million dollars).

8. $4503.8 = 202.9 + 11.2 + 13.7 + 1011.4 + 133.4 + 135.5 + 71.3 + 72.7 + 10.3 + 1285.0 + 1556.4$

In mathematical symbols:

8-A. $$X_4 = X_{14} + X_{24} + X_{34} + \ldots + X_{94} + M_4 + V_4$$

For the whole economy:

8-B. $$X_j = \sum_{i=1}^{n} X_{ij} + M_j + V_j$$

where:

X_j = total outlays (or purchases as presented in table 1)

M_j = imported imputs

V_j = Value added

X_{ij} = locally purchased intermediate imputs

From the above mentioned relations we can demostrate the relationship between input-output accounting and the income-expenditures approach of national accounting. Table 1 shows that total imports are $3733.6 millions. If we now add all rows first and then all columns of the inter-industry matrix, we obtain the total intermediate transactions equal to $5584.9 millions. Adding the total of final demands to intermediate transactions and deducting imports we obtain total production or:

9. $12071.1 = 5584.9 + 10219.8 - 3733.6$

In symbols:

9-A. $$\sum_{i=1}^{n} X_i = \sum_{i=1}^{n} \sum_{j=1}^{n} X_{ij} + \sum_{i=1}^{n} Y_i - \sum_{i=1}^{n} M_i$$

If we now want to obtain the total outlay for the whole economy we follow the same procedure as above but this time we sum first the columns and then rows. In numerical form:

10. $12,071.1 = 5584.9 + 6486.2$

10-A. $$\sum X_j = \sum_{j=1}^{n} \sum_{i=1}^{n} X_{ij} + \sum_{j=1}^{n} V_j$$

Since total outlays are equal to total production, combining equations (9) with (10) and deducting intermediate transactions we obtain the fundamental equation of aggregate national accounting (income-expenditure account) or:

11. $10219.8 - 3733.6 = 6486.2$

11-A. $$\sum_{i=1}^{n} Y_i - \sum_{i=1}^{n} M_i = \sum_{j=1}^{n} V_j$$

The left-hand side of the equation shows the expenditure approach used for the estimation of gross domestic product and the right-hand side the factor payment or income approach.

A final comment should be made concerning the relationship between economic modeling and input-output accounting system. In discussing

Leontief's system it is convenient to distinguish between the "input-output model", which deals with the behavior of the economic system, and the "input-output table or matrix" which is a purely definitional set of relationships that play an important role in modern national accounting systems. The value of the input-output table is indisputable whatever the merits of the model may be.

FOOTNOTES

1/ For a comparison of these three social accounting systems see: J. Sigel, "A Comparison of the Structures of Three Social Accounting Systems", in National Bureau of Economic Research, Input-Output Analysis: An Appraisal, Studies in Income and Wealth, Vol. 18 (Princeton University Press, 1955), pp. 253-89.

2/ In the United States during the 'Great Depression', in an economy with abundant resources and high percentage of unemployment, The Federal Government main interest in this field was in the aggregative aspects of national income instead of focusing on the structure of the accounts. On the other hand, during the 'full employment' years of World War II, more emphasis was given to the development of accounts structure. A set of interlocking and balancing national income and product accounts was developed. For more detail on this point see: Hermán I. Leibling "Interindustry Economics and National Income Theory", in NBER, Op. cit., pages 291-293. In relation to the analytical purpose of social accounts Leontief words express this very clear when talking about their use for economic development analysis. According to him "For the understanding that must preceede any constructive action it is necessary to penetrate below the surface of global statistics and such round terms as development". W. Leontief, "The Structure of Development" reprinted article from Scientific American, in Technology and Economic Development (Alfred A. Knopf, N.Y., 1963).

3/ Some people recomend international 'standardization of Input-Output Statistics' see, for instance, "Problems of Standardization of Input-Output Statistics: A Debate" in T. Barna (ed.) Structural Interdependence and Economic Development, Proceedings of An International Conference on Input-Output Techniques, Geneva 1961 (London McMillan and Co. Ltd. 1963) pages 333-365.

4/ Schumpeter, J.A., History of Economic Analysis (Oxford University Press, New York, 1954), pp. 213, 175, 241-243.

5/ Smith, Adam, Wealth of Nations, (Irwin Classics in Economics, Richard D. Irwin, Inc., Homewood, Illinois 1963), Vol. I, Book II, Chapter 2, pp. 218-219.

6/ Smith, Adam. Op. Cit., Vol. I, Book II, Chapter 3.

7/ Ricardo David, The Principles of Political Economy and Taxation, (J.M. Dent and Sons, Ltd. London 1957), Chapter XXVI.

8/ Schumpeter, J.A., Op. cit., page 628.

9/ Marshall, Alfred. Principles of Economics (McMillan and Co. Ltd., 8th. Edition London) Chapter 3, pp. 63-70. See also: Stewart, Kenneth, "National Income Accounting and Economic Welfare: The Concepts of GNP and MEW" (Measures of Economic Welfare) Federal Reserve Bank of St. Louis Review, Vol. 56, No. 4, pp. 18-23.

10/ It is important to observe, as Schumpeter does, that Smith's conception of 'productive and unproductive' labour can be subjected to two further distinctions. In his own words "the one springs from the fact that a private enterprise system generated incomes that provide consumption in two ways: directly for the consumption of those who 'earn' them, and indirectly for the consumption of those who are 'supported' by them... the other meaningful distinction springs from the fact that services of labor (or of natural agents) that are directly bought and consumed by households, such as the services of servants, teachers, and physicians, occupy a position in the economic process that is different from the position of services of labor that are bought and 'consumed' by firms and have economically speaking still to go through a business process... the first man to see this quite clear was Marx, who adopted our second distinction, giving Adam Smith ample credit for having uncovered so important an element of the structure of the Capitalist society". J.A. Schumpeter, Op. cit., pp. 628-631.

11/ See for instance, Paul Studensky, "Methods of Estimating National Income In Soviet Russia", Studies in Income and Wealth, Vol. VIII (NBER, New York, 1946) pp. 195-234.

12/ Holesousky Vaclav, "Karl Marx and the Soviet National Income Theory", American Economic Review, (June 1961).

13/ These studies are closely connected with the name of Simon Kuznets whose contributions to the development of national income statistics have been greatly significant.

14/ According to Liebling, "Earlier political arithmeticians of the seventeenth century such as Petty, King and others also recognized in the structure of their accounts the intermediate and final product relationships of economic processes", Liebling, Op. Cit., page 292.

15/ For instance, Marquis de Mirabeau declared it to be one of the three greatest discoveries since the World began and K. Marx, writing about the Tableau, opined that "Never before had thinking in political economy reached such heights of genius". Both quoted in Almarin Phillips "The Tableau Economique as a Simple Leontief Model", Quarterly Journal of Economics, February 1955 (original quotes were in Adam Smith, The Wealth of Nations, Cannan Edition; II 177 n, and K. Marx, A History of Economic Theories (Kar Kautsky ed.), N.Y. 1952.

16/ Blaug, M., Economic Theory in Retrospect, Richard D. Irwin, Inc., Illinois, page 26.

17/ Leontief, W., The Structure of the American Economy, 1919-1939, Oxford University Press, New York, 1951, page 9.

18/ Mathur, P.N., "Introduction" to A. Carter and A. Brody (ed.) Contributions to Input-Output Analysis, Vol. I, North Holland Publishing Co., Amsterdam 1970, page 1.

19/ The example will be based in the latest Input-Output Table published by the Puerto Rico Planning Board in 1972.

20/ Sigel Stanley J., Op. Cit., page 253-289, also H.L. Liebling, Op. Cit., pp. 291-320.

21/ Sigel S.J., Op. Cit., page 257.

22/ For a review on aggregative econometric models see: Christ Carl F., "Aggregate Econometric Models", American Economic Review, June 1956, pp. 385-408.

23/ For instance, criticisms related to the constancy of input-output coefficients. The effects of change in relative prices or changes in output mix.

24/ In the International Economics field input-output system has been used together with the theory of Comparative Costs by Leontief. Leontief's article on this field gave origin to a famous controversy centered around the so called "Leontief Paradox". On this see:

W. Leontief, "Domestic Production and Foreign Trade; The American Position Re-Examined" Proceedings of the American Philosophical Society, Sept. 1953.

_____, "American Trade: Further Theoretical and Empirical Analysis", The Review of Economic and Statistics, Nov. 1956.

For an exposition and a theoretical explanation of this "paradox" see P.N. Mathur, "Gains in Economic Growth from International Trade - A Theoretical Explanation of Leontief Paradox", Kiklos, volume 16 (1963). Also in the field of International Economics a "new use" of input-output system was introduced by H. Chenery and Watanabe, see their article, "International Comparisons of the Structure of Production" Econometrica, october 1958.

In Economic Development and Planning important contributions have been made by P.N. Mathur, W. Leontief, H.B. Chenery and others. See Leontief's article for Scientific American; P.N. Mathur "An Efficient Path for the Technological Transformation of an Economy" in T. Barna, op. cit. Also in Part I of this later book other important contributions are made by Chenery and others.

Regional Economics is another field where fruitful applications of input-output analysis have been made by W. Isard, P.N. Mathur, Eugene Smolensky, W. Leontief and others. See T. Barna, Op. Cit., Part II and P.N. Mathur "Economic Implications of Transport Cost Minimization In A Dynamic Input-Output Framework," in Fifth International Conference on Input-Output Techniques Geneva 1971, North Holland Publishing Co. Amsterdam.

25/ In a pure accounting sense they really are single-entry since there is one entry for each party involved. The Flow of Funds system, on the other hand, can be trully classified as a double-entry system.

26/ Flow of Funds sectoring is on institutional basis, see Sigel, op. cit., page 275.

27/ U.S. Department of Commerce "The Interindustry Structure of the United States, A Report on the 1958 Input-Output Study", Survey of Current Business, November 1964.

28/ Chenery H.B. and P.G. Clark, Interindustry Economics (Wiley and Sons 1959), Chapter 2, Part. A.

29/ Richardson, Harry W. Input-Output and Regional Economics, (World University London 1972), page 14.

30/ Liebling, Herman I. Op. Cit., page 313.

31/ For the sake of clarity we are repeating in this section the equations of section II.

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